Note on the osteology and taxonomic position of African Long-tailed Hawk *Urotriorchis macrourus* (Aves: Accipitridae)

by Jiří Mlíkovský

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The African Long-tailed Hawk *Urotriorchis macrourus* inhabits tropical rain forests of Central Africa (Grossman & Hamlet 1964, Brown & Amadon 1968, Brown *et al.* 1982, del Hoyo *et al.* 1994). The species was first described by Hartlaub (1855: 353) in the genus *Astur* Lacépède, 1799 [*Accipiter* Brisson, 1760]. Cassin (1859: 33) transferred it to *Micrastur* Gray, 1841, but the latter genus was later shown to belong in the Falconidae (Ridgway 1874, 1875, Jollie 1977b). Later, Sharpe (1874: 83) created for *macrourus* the monotypic genus *Urotriorchis*. All subsequent authors considered *macrourus* to be an aberrant *Accipiter*, either including it in this genus, or listing it next to it. Del Hoyo *et al.* (1994: 164) summarized current opinions on the taxonomic position of *Urotriorchis* as follows: "Monotypic genus, apparently very close to *Accipiter*, with which it has been merged; has also been linked with other endemic African genera, *Melierax* and *Kaupifalco*."

Almost all of these taxonomic assignments were based on the external morphology of the bird. Jollie (1976: 162) listed *Urotriorchis macrourus* among the species he examined osteologically, but both comments on *Urotriorchis* in his 342 pages long paper concerned feathers, which casts some doubts on his statement. Hence, the only comments on the osteology of *Urotriorchis macrourus* are those of Olson (1982, 1987), which concern the presence of the procoracoid foramen, and the absence of fused phalanges of the inner toe, respectively, in this species. Olson (1987) was the first to indicate that *Urotriorchis macrourus* might not be closely related to *Accipiter*.

While identifying unusual ungual phalanges of accipitrid birds from the early Miocene locality Tuchořice in the Czech Republic (see Mlíkovský in press), I observed that their aberrant structure is unique, within the Accipitridae, to a group of large, tropical eagles, particularly *Polemaetus* and *Spizaetus*, plus *Urotriorchis* (see below for details), which provided further support for Olson's (1987) conjecture, that *Urotriorchis* is not related to *Accipiter*. My reinvestigation of a skeleton of *Urotriorchis macrourus*, described below, showed that this species is indeed not related to *Accipiter*, and belongs in the *Polemaetus* group of eagles.

Material examined

I examined skeletons of raptors in the collections of the National Museum of Natural History, Smithsonian Institution, Washington,

D.C. Additional specimens were examined in my collection in Praha, Czech Republic. Ungual phalanges were examined in all the taxa listed below. Complete skeletons were used for comparisons in the taxa marked with an asterisk.

The following taxa of the Accipitridae were found to possess the unique structure of ungual phalanges: *Lophaetus occipitalis*, **Spizaetus ornatus*, **S. tyrannus*, **S. limnaeetus*, *Stephanoaetus coronatus*, **Polemaetus bellicosus*, and **Urotriorchis macrourus*. The examined specimen of *Urotriorchis macrourus* was a male (USNM 292398), collected by J. A. Reis on 6 August 1928 near Efulan in Cameroon.

The following taxa of the Accipitridae do *not* possess the unique structure of ungual phalanges: *Aviceda subcristata*, *Leptodon cayanensis*, *Choudrohierax uncinatus*, *Peruis apivorus*, *Elanoides forficatus*, *Machaerauphus alcinus*, *Gampsonyx swainsonii*, *Elanus caeruleus*, *Chelictinia ridcourii*, *Rosthramus sociabilis*, *Harpagus bidentatus*, *Ictinia plumbea*, *Milvus migrans*, *Haliastur indus*, *Haliaeetus leucocephalus*, *Ichthyophaga humilis*, *Gypohierax angolensis*, *Gypaetus barbatus*, *Neophron percuopterus*, *Necrosyrtes monachus*, *Torgos tracheliotus*, *Trigonoceps occipitalis*, *Gyps fulvus*, *Aegypius monachus*, *Circaetus gallicus*, *Terathiopius ecaudatus*, *Spilornis holospilus*, *Polyboroides typus*, *Circus aeruginosus*, **Melierax canorus*, **Accipiter gentilis*, **A. griseogularis*, *A. nisus*, *Butastur indicus*, **Kaupifalco monogrammicus*, *Heterospizias meridionalis*, *Geranospiza caerulescens*, *Leucopternis albicollis*, *Buteogallus anthracinus*, *Parabuteo unicinctus*, *Busarellus nigricollis*, *Geranoaetus melanoleucus*, *Buteo jamaicensis*, *B. buteo*, *Harpia harpyja*, *Aquila chrysaetos*, *Hieraeetus fasciatus*, and *Spizastur melanoleucus*. The unique condition of ungual phalanges was also not found in the Sagittariidae (*Sagittarius serpentarius*), Pandionidae (*Pandion haliaeetus*), nor Falconidae (*Herpetotheres cachinnans*, *Micrastur semitorquatus*, *Falco tinnunculus*).

Osteology

Urotriorchis differs from *Accipiter* in a number of osteological characters, and agrees in them with the *Polemaetus* group of eagles. The **coracoid** of *Urotriorchis* differs from the same element of *Accipiter* in having a coracoidal fenestra present (see also Olson 1987). In this character *Urotriorchis* agrees with most Accipitridae, including *Polemaetus*, *Spizaetus*, *Kaupifalco* and *Melierax*. The **scapula** of *Urotriorchis* differs from the same element of *Accipiter* in having the pneumatic foramen on the dorsal side of the neck (in *Accipiter* this foramen is on the ventral side). The **furcula** of *Urotriorchis* is markedly narrow, while the same element of *Accipiter*, *Kaupifalco*, *Melierax*, *Spizaetus* and *Polemaetus* is broad. On the **sternum**, the ventral manubrial spine is short and blunt in *Urotriorchis*, *Spizaetus* and *Polemaetus*, while it is long and projecting in *Accipiter*, *Kaupifalco* and *Melierax*. Sternal fenestra are large in all species except *Polemaetus*, in which they are reduced. The posterior border of the sternal plate is approximately straight in *Accipiter*, *Melierax* and *Kaupifalco*, while it is concave in *Urotriochis*, *Polemaetus* and *Spizaetus*. Carina is well

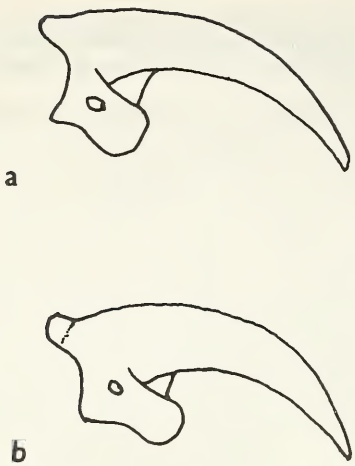

Figure 1. Schematic drawings of ungual phalanges of *Aquila chrysaetos* (a) and *Polemaetus bellicosus* (b), showing generalized and derived condition of the dorsal end of articular surface, respectively.

developed in *Accipiter*, *Kaupifalco* and *Melierax*, while it is reduced in *Urotriorchis*, *Polemaetus* and *Spizaetus*. The relation of maximal height of carina (A) to maximum length of sternum without manubrial spine (B) is 43.1–46.7% in the former group, and 35.7–40.5% in the latter group. Exact data are 43.1 in *Accipiter gentilis* (A/B=34.5/80), 43.8 in *Accipiter griseogularis* (16/36.5), 46.7 in *Kaupifalco monogrammicus* (17.5/37.5), 43.3 in *Melierax metabates* (26/60), 40.5 in *Polemaetus bellicosus* (45/111), 38.3 in *Spizaetus ornatus* (24.5/64), 37.2 in *Spizaetus limnaeetus* (29/78), 35.7 in *Spizaetus tyrannus* (23/64.5), and 38.4 in *Urotriorchis macrourus* (21.5/56) (n=1 in each case; the measured specimen of *Accipiter gentilis* was a female, all others were males). The **ulna** has the impression of *brachialis anticus* distinct and distally bordered in *Accipiter* and *Kaupifalco*. This impression is indistinct and distally not bordered in *Urotriorchis*, *Polemaetus*, *Spizaetus* and *Melierax*. The **phalanx I digiti II** possesses a tendineal elevation on the external side of its metacarpal facet in *Accipiter* and (slightly) in *Kaupifalco*. This elevation is absent in *Urotriorchis*, *Polemaetus*, *Spizaetus* and *Melierax*. On the **tarsometatarsus**, the trochlea for digit II is medially bent in *Accipiter* and *Melierax*, while it is posteriomedially straight in *Urotriorchis*, *Polemaetus*, *Spizaetus* and *Kaupifalco*. **Ungual phalanges** are unique in *Urotriorchis*, *Polemaetus*, *Spizaetus*, *Spizastur* and *Lophaetus* in having a broad, well developed and elevated facet posterio-dorsally to the articular surface (Fig. 1). This facet is well separated from the dorsal surface of the claw by a transverse ridge. In *Stephanoaetus*, the facet is also developed, but is short. In *Polemaetus*, *Spizaetus* and *Urotriorchis*, the articular surface is distinctly heart-shaped (broad ventrally and narrow

dorsally), and the heel is laterally flattened, so that its ventral border forms a sharp ridge. In *Lophaetus*, the articular surface is more rounded.

The bones not mentioned yielded no distinct characters, or the characters were found variable within the genera and, hence, unsuitable for any use in supraspecific classification.

Discussion

The discovery of two unique characters within the Accipitridae, viz. fused phalanges of the inner toe (see Olson 1987), and specifically developed facet on the ungual phalanx (this paper), indicates that large, non-vulturid accipitrids, which are generally called "eagles", form at least three groups, and may have evolved three times within the Accipitridae. I found the unique morphology of ungual phalanges described above in the genera *Spizastur*, *Lophaetus*, *Spizaetus*, *Stephanoaetus*, *Polemaetus* and *Urotriorchis*. The former five genera of large tropical eagles are usually considered closely related (Brown & Amadon 1968, Jollie 1977b, Amadon & Stresemann 1979, Kemp & Crowe 1990, Sibley & Monroe 1990, Holdaway 1994), and this new character supports their close relationship. *Urotriorchis* was usually considered closely related to *Accipiter*, *Melierax* and *Kaupifalco* (Amadon 1978, del Hoyo *et al.* 1994), or even included in *Accipiter* (Wolters 1977–1982). Additional osteological characters mentioned above confirm that *Urotriorchis* should be transferred from the Accipitrinae (sensu Jollie 1977b) to the *Polemaetus* group of eagles. On the other hand, *Melierax* and particularly *Kaupifalco* are osteologically close to *Accipiter*, although *Accipiter* is unique in having no procoracoid foramen (see Olson 1982).

The fossil record of the *Polemaetus* group of eagles goes back to the early Miocene of Europe, where *Polemaetus* sp. was found in St.-Gérand-le-Puy (MN 2 sensu Mein 1990) in France and in Tuchořice (MN 3) in the Czech Republic (Mlíkovský in press). Here, *Polemaetus* is a welcome addition to the tropical avifauna, which inhabited Europe in that time (Mlíkovský 1996). The next oldest record is *Spizaetus schultzi* Martin, 1975 from the late Miocene (Hemphillian s. str.) of Cambridge in Nebraska (see Becker 1987 for the age of this locality). All other records are limited to the Pleistocene of North America and Mexico, from which several fossil species have been described. They include *Spizaetus pliogryps* (Shufeldt, 1892) from Oregon, *Spizaetus grinnelli* (Miller, 1911) from California, *Spizaetus willetti* Howard, 1935 from Nevada, *Spizaetus tanneri* Martin, 1971 from Nebraska, and *Neogyps errans* Miller, 1916 from California. The last species, which is based on a tarsometatarsus from the late Pleistocene of Rancho La Brea, was originally thought to represent a New World vulture (Miller 1916), and later allied with *Gypaeetus* (Brodkorb 1964), but Jollie (1977a, b) showed that it belongs in the *Polemaetus* group of eagles, without discussing its generic status. Taxonomic identity of all of the Pleistocene species needs confirmation,

however, because such a diversity of tropical (!) eagles in Pleistocene North America seems improbable.

Three eagle genera—*Haliaeetus*, *Ichthyophaga* and *Busarellus*—do not share the unique morphology of ungual phalanges with the eagles from the *Polemaetus* group. Unlike the *Polemaetus* group, these three genera have fused phalanges of the inner toe, a unique character which allies them with kites of the genera *Haliastur*, *Milvus* and *Ictinia* (Olson 1982).

Of the remaining eagle genera, *Aquila*, *Hieraeetus*, *Harpia*, *Terathopius*, *Spilornis* and *Geranoaetus* possess neither of these unique characters. *Pithecophaga* and *Harpyopsis* do not possess fused phalanges of the inner toe (Olson 1982, Boles and Lowe 1985), but their ungual phalanges remain undescribed. Not available for study were the eagle genera *Dryotriorchis*, *Eutriorchis*, *Harphyaliaetus* and *Oroaetus*. American Quaternary eagles of the genera *Titanohierax* Wetmore, 1937 and *Amplibuteo* Campbell, 1979 do not appear to belong to any one of the two well defined eagle groups (see Olson & Hilgartner 1982), as does *Harpagornis* from the Quaternary of New Zealand (Holdaway 1991).

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Address: Jiří Mlíkovský, Institute of Geology and Paleontology, Charles University, Albertov 6, CZ-128 43 Praha 2, Czech Republic.